

CALIBRATION STANDARD REQUIREMENT

FOR A

DC REFERENCE STANDARD

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PROCUREMENT PACKAGE

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DC REFERENCE STANDARD

1. SCOPE

1.1 Scope. This requirement defines the mechanical, electrical, and electronic characteristics for a DC Reference Standard. This equipment is intended to be used by Navy personnel in shipboard and shorebased laboratories with a Reference Divider and Null Detector to perform calibrations and to serve as a reference and transfer standard for the unit of direct voltage. For the purposes of this requirement, the DC Reference Standard shall be referred to as the DC RS.

2. APPLICABLE DOCUMENTS

2.1 Controlling Specifications. MIL-T-28800, "Military Specification, Test Equipment for use with Electrical and Electronic Equipment, General specification for," and all documents referenced therein of the issues in effect on the date of this solicitation shall form a part of this requirement.

3. REQUIREMENTS

3.1 General. The DC RS shall conform to the Type II, Class 5, Style E requirements as specified in MIL-T-28800 for Navy shipboard and shorebased equipment as modified below. The use of material restricted for Navy use shall be governed by MIL-T-28800.

3.1.1 Design and Construction. The DC RS design and construction shall meet the requirements of MIL-T-28800 for Type II equipment.

3.1.2 Power Requirements. The DC RS shall operate from a source of 103.5V to 126.5V at 50 Hz and 60 \pm 5% single-phase input power as specified in MIL-T-28800.

3.1.2.1 Fuses or Circuit Breakers. Fuses or circuit breakers shall be provided. If circuit breakers are used, both sides of the power source shall be automatically disconnected from the equipment in the event of excessive current. If fuses are used, only the line side of the input power line, defined by MIL-C-28777, shall be fused. Fuses or circuit breakers shall be readily accessible.

3.1.2.2 Power Connection. The requirements for power source connections shall be in accordance with MIL-T-28800 with a 6-foot minimum length cord.

3.1.3 Dimensions and Weight. Maximum dimensions shall not exceed 18 inches in width, 8 inches in height, and 25 inches in depth. The weight shall not exceed 45 pounds.

3.1.4 Lithium Batteries. Per MIL-T-28800, lithium batteries are prohibited without prior authorization. A request for approval for the use of lithium batteries, including those encapsulated in integrated circuits, shall be submitted to the procuring activity at the time of submission of proposal. Approval shall apply only to the specific model proposed.

3.2 Environmental Requirements. The DC RS shall meet the environmental requirements for a Type II, Class 5, Style E equipment with the deviations specified below.

3.2.1 Temperature and Humidity. The DC RS shall meet the conditions below:

	<u>Temperature(°C)</u>	<u>Relative Humidity (%)</u>
Operating	10 to 30	95
	30 to 40	75
Non-operating	0 to 50	Not Controlled

3.2.2 Electromagnetic Compatibility. The electromagnetic compatibility requirements of MIL-T-28800 are limited to the following areas: CE01, CE02, CS01, CS02, CS06, RE01, RE02 (14 kHz to 1 GHz), and RS03.

3.3 Reliability. Type II reliability requirements are as specified in MIL-T-28800.

3.3.1 Calibration Interval. The DC RS shall have an 85% or greater probability of remaining within tolerances of all specifications at the end of a 12 month period.

3.4 Maintainability. The DC RS shall meet the Type II maintainability requirements as specified in MIL-T-28800 except the lowest discrete component shall be defined as a replaceable assembly. Certification time shall not exceed 60 minutes.

3.5 Performance Requirements. The DC RS shall provide the following capability as specified below. Unless otherwise indicated, all specifications shall be met following a 24-hour warm-up period.

3.5.1 Outputs. The DC RS shall have a 10V, 1.018V, and 1V outputs that meet the specifications herein.

3.5.1.1 Output Voltage Stability. The relative output voltage stability shall be maintained within the limits specified herein for a 24 hour period at $\pm 5^{\circ}\text{C}$.

<u>OUTPUT UNCERTAINTY</u>	
<u>OUTPUT VOLTAGE</u>	<u>OUTPUT STABILITY (PPM)</u>
10V	0.05
1.018V	1.00
1.00V	1.00

3.5.1.2 Transfer Stability. The output voltage stability shall not exceed the values shown in the Transfer Stability Table when the temperature is maintained within $^{\circ}\text{C}18$ to 28°C . The Transfer Stability Table is based on continuously powered operation.

TRANSFER STABILITY

<u>OUTPUT VOLTAGE</u>	<u>OUTPUT STABILITY IN PPM</u>			
	<u>30 DAYS</u>	<u>90 DAYS</u>	<u>6 MONTHS</u>	<u>1 YEAR</u>
10v	± 0.5	± 1.0	± 1.5	± 3.0
1.018V	± 1.5	± 4.0	± 6.0	± 12.0
1V	± 1.5	± 4.0	± 6.0	± 12.0

3.5.1.3 Temperature Coefficient of Output. The table below defines the specifications for degradation due to temperature changes. The DC RS shall not exceed these limits.

<u>OUTPUT VOLTAGE</u>	<u>TEMPERATURE COEFFICIENT (PPM/$^{\circ}\text{C}$)</u>	
	<u>0° TO 18°C</u>	<u>28° TO 40°C</u>
10V	0.05	0.05
1.018V	1.0	1.0
1V	1.0	1.0

3.5.1.4 Line Regulation. The change in output shall not be greater than 0.05 ppm for $\pm 10\%$ line voltage variation.

3.5.1.5 Output Adjustments. The DC RS outputs shall each be adjustable for at least the range provided below along with equal or better resolution. The adjustments shall be accessible at the front panel and shall be protected in such a manner to prevent accidental adjustment.

<u>OUTPUT VOLTAGE</u>	<u>ADJ RANGE</u>	<u>ADJ RESOLUTION</u>
10V	50uV	(0.10 PPM)
1.018V	50uV	(0.20 PPM)
1V	5uV	(0.20 PPM)

3.5.1.6 Output Protection. The outputs of the DC RS may be shorted indefinitely without any permanent damage. Up to 1000V with 25ma current limit may be applied between plus and minus terminals without damaging the instrument. The DC RS shall not take longer than two minutes to resume normal operation after the short or voltage is removed with no loss of stability or accuracy.

3.5.1.7 Output Noise. The output noise shall be no more than the limits specified in the table below.

NOISE LEVEL FOR 0.1 Hz TO 10 Hz

10V	1uV RMS
1.018V	.1uV RMS
1.00V	.1uV RMS

3.5.1.8 Output Current. The minimum output currents shall be 0 to 12mA for the 10V output and 0 to 1mA for the 1.000V and 1.018V outputs.

3.5.1.9 Load Regulation. For an output current change from 0mA to 12mA or from 12mA to 0mA, the 10V output shall not change more than 1.5ppm.

3.5.1.10 Guard Protection. Guard protection shall be provided to isolate the internal circuitry from the chassis and earth ground. A guard terminal shall be provided to reduce output voltage errors caused by undesirable circulating ground currents.

3.5.1.11 Output Terminals. All output terminals shall be banana jack combination binding posts made of 99% pure copper with 1% tellurium. The terminals shall be accessible at the front and clearly marked to indicate their functions. Terminals connections shall include the plus, minus, chassis ground, and guard.

3.5.1.12 Output Impedance. The output impedance for the 1V and 1.018V outputs shall not exceed 1100 ohms. The output impedance for the 10V output shall not exceed 5 milliohms.

3.5.2 Battery. The DC RS shall be provided with an internal battery system which can provide continuous operation within the requirements of the specification for up to 12 hours^{at 23}

3.5.2.1 Lab Application. The battery system shall provide continuous operation for up to 12 hours. The battery system shall act as a back-up if the previously specified ac power goes below 30% of its nominal value. Switching to battery operation shall be automatic.

3.5.2.2 Portability. The battery shall provide continuous standby operation for up to 24 hours when the DC RS is in transit. Normal handling and transportation shall not alter the accuracy or stability of the DC RS if it is maintained by the battery source and the DC RS has not been exposed to ambient temperature beyond the operating ranges as specified in paragraph 3.5.

3.5.2.3 Recharge Time. The battery recharge time shall not exceed 24 hours.

3.5.2.4 Battery Indication. A visual indication shall be provided to indicate whether or not the battery is charging.

3.5.2.5 Battery Life. Under normal operation the battery life shall not be less than 5 years before replacement is required.

3.5.2.6 Internal Battery Operation. An internal battery charger capable of charging the battery(s) when the DC RS is connected to the previously specified ac power source shall be provided.

3.6 Operating Requirements. The DC RS shall provide the following operating capabilities.

3.6.1 Front Panel Control Requirements. All modes and functions shall be operable using front panel controls. The locations and labeling of indicators

controls, and switches shall provide for maximum clarity and easily understood operation without reference to tables, charts, or flow diagrams.

3.7 Manual. At least two copies of an operation and maintenance manual shall be provided. The manual shall meet the requirements of MIL-M-7298.

3.7.1 Calibration Procedure. The manual shall provide a DC RS calibration procedure in accordance with MIL-M-38793.

3.8 Accessories. The DC RS shall include the following:

3.8.1 One power cable in accordance with MIL-T-28800 with a minimum length of 6 feet.

3.8.2 Low Thermal emf cable assembly connectors shall be spade lug and made of the same material as the binding posts.